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ABSTRACT

This document provides a summative evaluation of an ongoing collaborative professional development project that focuses on a course in experimental science learning. Project goals include: (1) providing elementary school teachers with a professional development program for science education that is grounded in the National Science Education Standards; (2) developing a collaborative model for restructuring and improving a teacher education program; and (3) enabling teachers to gain personal experience, knowledge, and confidence in the scientific investigation of questions pertaining to earth, space, life, and physical sciences. The goals of the course include providing teachers of kindergarten through Grade 3 students with inquiry-based scientific activities, teaching science as inquiry, and laying the foundations for district-wide systemic change. (DDR)

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ED 417 958

Southern Connecticut State University and Dwight D. Eisenhower Higher Education Professional Development Program Grant

EDU 526 Experiential Science Learning I:
A Collaborative Model for Professional Development

1997 SUMMATIVE EVALUATION

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EXECUTIVE SUMMARY

In 1996-1997, the Southern Connecticut State University (SCSU) collaborated with the New Haven Public School (NHPS) system to provide local school teachers in grades K-3 with professional development in science education. The initiative was funded by a grant of $ 24,995 from the Connecticut Department of Higher Education Eisenhower Professional Development Program. The three-fold purpose of this project was (1) to improve teachers' science content knowledge, (2) to improve their methods of teaching science consistent with the *National Science Education Standards*, and (3) to develop a collaborative model for restructuring and improving the University's teacher education program.

The principal investigator, Dr. David Pettigrew, associate professor of the Philosophy Department at SCSU, collaborated with Dr. James Dolan, chairman of the Physics Department, and Ms. Margaret Andrews, co-teacher from Helene Grant Elementary School in New Haven, to implement the project. A total of 13 teachers and 2 building principals from grades K-3 participated in this project.

The key aspect of this project was teachers' enrollment and subsequent successful completion of a 1996 summer session graduate course at SCSU, called "EDU 526 Experiential Science Learning I: A Collaborative Model for Professional Development." The course content emphasized not only acquisition of up-to-date science knowledge for adult learners, but also teachers' gaining substantial practical experience with scientific experiments. The teachers' learning in the university classroom and laboratories would have important implications for their subsequent teaching of science to the K-3 students' in the elementary schools. During the 1996-1997 school year following EDU 526, the teachers joined their professors and co-teacher in several dialog sessions designed to facilitate teachers' implementation of the new science curriculum, to support discussion of relevant issues, and to augment further collaboration between individuals and institutions.

The evaluation study was conducted during the year-long project by Curriculum Research & Evaluation (CRE). Methods of data collection included both quantitative and qualitative strategies. Analysis of data reveals that teachers believe they have benefitted from the university course, in that their participation led to improved levels of science content knowledge and science teaching skills. Also, the group discovered important insights regarding curriculum and professional development in science, specific to the NHPS system and, most likely, to other urban school systems. Namely, restructuring the science curriculum in the K-3 grades should be done on a building by building basis, requires ample support from the building principal, and benefits significantly from a critical mass of teachers in the building who are committed to the restructuring process. In addition, the school teachers and university professors recognize that there is a need to develop a district-based, scope and sequence for the K-3 science curriculum that is consistent with the national standards in science education. The Dean of the School of Education and other faculty at SCSU support the collaborative model and changes in courses for pre-teacher certification and inservice for teachers' professional development. Finally, although there were a number of relatively minor misunderstandings between administration officials from the NHPS and key members of the project, there were no significant problems. The project completed all of its objectives and activities in a timely manner.

CRE concludes that this initiative was successful and the project leaders should be commended for their accomplishments. Nonetheless, there is much work that remains to be done before there are strong signs that an up-to-date inquiry-based elementary science curriculum is fully operational in NHPS. Thus, CRE would strongly recommend the continuation and advanced development of this initiative in New Haven and the implementation of similar efforts statewide. Also, subsequent initiatives should emphasize teachers' accountability for the evaluation studies, with particular reference to revealing the project's impact on their professional knowledge and skills in science teaching and their students' achievement in science.

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EDU 526 Experiential Science Learning I: A Collaborative Model for Professional Development 1997 SUMMATIVE EVALUATION

INTRODUCTION

"EDU 527 Experiential Science Learning I" is an important element of an ongoing collaborative effort between Southern Connecticut State University (SCSU) and the New Haven Public Schools (NHPS). The project's goals are: (1) to provide elementary school teachers with a professional development program for science education that is grounded in the *National Science Education Standards;* (2) to develop a collaborative model for restructuring and improving the SCSU teacher education program; and (3) to enable teachers to gain personal experience, knowledge, and confidence in the scientific investigation of questions pertaining to earth, space, life, and physical sciences. In spring 1997, the principal investigator and associates at SCSU and NHPS received a follow-up Eisenhower grant to implement phase two of this experiential science course.

The graduate level course for phase one, EDU 526, was designed by the principal investigator and his associates to accomplish the following results: (1) to provide teachers in grades Kindergarten through 3 with inquiry-based scientific activities, (2) to teach science as inquiry, (3) to involve teachers in intellectually stimulating activities for adults, (4) to lay the foundations for district-wide systemic change, (5) to develop collaborative teams of change agents at the respective schools, and (6) to provide university-level courses that respond to the professional development needs of teachers.

Successful completion of this project would entail the following outcomes:

(1) institutionalize collaboration between SCSU science faculty and the NHPS teachers for timely professional development of the school district's K-12 science teachers;
(2) offer a graduate science course that meets the challenge and goals of the National Science Education Standards;
(3) introduce NHPS elementary teachers to the National Science Education Standards;
(4) prepare the NHPS teachers to use hands-on, inquiry-based, problem-solving learning activities for grades K-3;
(5) provide teachers with expanded knowledge of science content and deepened appreciation of the scientific method;
(6) establish action teams of two teachers at each elementary school who are trained in the kit-based learning models;
(7) supply participants' schools with $500 grants to purchase teaching kits, including: Science and Technology for Children, Insights, or Science Place; and
(8) provide ongoing support for participants during the school year through four workshops and four networking activities.

This is a summative report of the results of "EDU 526 Experiential Science Learning I." In February 1997, CRE submitted an interim report on the project's development (see Appendix). Documentation collected and analyzed during the 1996-97 academic year by Curriculum Research

& Evaluation indicates that the project has accomplished its objectives in a timely manner, was responsive in its development of specific activities, and the project's key participants held difficulties to a minimum. Briefly, teachers who participated in this project expressed high regard for the professional development they received in science knowledge, teaching methods, and curriculum materials. Furthermore, data indicate that the various partners in this collaborative venture have succeeded in establishing a foundation in the NHPS for improving teachers' science knowledge, their methods of teaching science, and their confidence about implementing inquiry-based science learning activities in their classrooms.

METHODOLOGY

The methods CRE employed to study the development and impact of this project included: collection of relevant documents, observation of participants during the project's activities, interviews with key players, and surveys of participants (see Appendix). Also, during the year, CRE provided consulting services to the principal investigator and associates on the project's development and related interests. In general, CRE was able to assemble sufficient data in all areas of interest to assess the project.

However, two aspects of the data collection process that will need attention in the future are: measured or descriptive data on the teachers' response and on children's learning. CRE encountered some difficulty with gaining the cooperation of teachers for classroom-level data collection. Teachers as an occupational group nationally resist holding themselves accountable for their development of knowledge and skills that are necessary for effective instruction and, especially, to recognize that the fact of their professional development should lead eventually to higher quality learning on the part of their students. The teachers who participated in this project cooperated with the evaluation, but they were no exception in regard to resisting full-scale accountability.

CRE encourages project directors, funding agencies, and educators at all levels to acknowledge that a causal relationship does exist between the teacher's practice and students' learning. Simply put, good teaching promotes good learning. Of course, this relationship between teachers and students is complicated by sociological and political exigencies at various levels and across different communities. Known and unknown variables confuse the studies of interactions in all of the sciences. However, parents know very well that it makes a great difference who is the teacher of their child. After teachers' participation in projects such as this one, we should see them engaged in different or advanced levels of activity with science teaching in their classrooms. We should also see their students' knowledge and skills in science are improving.

CRE suspects that the participating teachers' practice has changed as a result of this project, but at this time we have only anecdotal data to support our opinion. In the future, we suggest that project directors and funding agencies establish conditions so that teachers' who participate in professional development projects hold themselves accountable for *sustainable change* in their teaching practice and for producing both measurable and descriptive, positive differences in their students' science achievement. In the least, teachers' responsibility to contribute substantially to the evaluation study should be a condition for their participation.

OVERVIEW

The project's activities included offering "EDU 526 Experiential Science I" during SCSU's second summer session in 1996, conducting follow-up meetings to provide support during teachers' implementation of the new science curriculum, and offering relevant workshops to deepen the coverage and extent the impact to more teachers and school buildings.

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This report of findings begins with an analysis and discussion of survey data. Next there is a discussion of data obtained during observations and interviews. The report closes with a summary statement and recommendations.

HIGHLIGHTS OF INTERVIEWS AND OBSERVATIONS

This approach to science education requires that teachers become familiar through individual and collaborative practice sessions with the science kits. For instance, teachers and instructors in the EDU 526 course said that it would not be wise for a teacher to pick up the kits on Monday morning, start with page one, and proceed through the pages of a booklet to completion of the lesson. The most convincing evidence for this conclusion came from Professor Dolan, who reported that even he had some trouble getting supplies, such as insects, in time for his lessons. Not only does the teacher have to place the orders in time, but also he/she has to maintain close contact with the supply sources and shipping process to make sure that the insects are delivered alive, healthy and on time.

The new science curriculum materials are interdisciplinary, in that they incorporate not only math and science, but also language arts. For example, the lessons include writing and reading, study skills, logical thinking, and problem-solving. Also, teachers report that their students are engaged in observation, writing descriptive details, discussion of effects, and developing rationales. There is a substantial amount of mathematics, including graphing results. The district's curriculum director was sufficiently impressed with the content of the EDU 526 course that he thought it would be good for the high school and middle school teachers, as well as for the K-3 teachers. To encourage teachers to engage in critical thinking about science, Professor Dolan would present a "Wrong Fact of the Day" in the EDU 526 course. This tactic promoted a critical attitude among the teachers toward so-called science facts, wherever they find them, but especially in outdated textbooks. They might continue this strategy with their students.

The teachers and professors have discovered that the more teachers work on teaching science in this curriculum the more the process and materials lend themselves to teaching other disciplines simultaneously. Also, as a result of the EDU 526 course, teachers begin to think about how to make their lessons more activity-based than previously, so that their students are active learners in the classroom. In other words, there is a carryover to other areas of their teaching responsibility. The team also discovered that, to the extent the science curriculum works at one school, then they can see it more and more as a model that can be spread by example to other schools.

Where the principal is an instructional leader, such as at Lincoln-Bassett, and where there is a critical mass of teachers who are investing in their professional development, there is a successful implementation of the new science curriculum. Where the principal is not a good instructional leader or where there is not a critical mass of teachers committed to high quality science teaching, the children have an uneven development of science knowledge and skills as they matriculate through grades K-3 (and by extension, K-12).

The high mobility rate of children in the school district means that some of the children will have been made familiar with a kit and its experiments in another building. Thus, teachers have to be aware of this circumstance and be prepared to present sufficient variety and challenge to all of the children.

Teachers were in agreement about the high quality of the science kits. When asked for their opinions about the kits, they would say emphatically "these science materials are *good*." When the teachers were asked to comment on any shortcomings of the materials, they would say there is as yet no scope and sequence of goals and objectives to accompany the kits for the K-3 grades that are

district-based and tied to the National Standards for Science Education.

During the follow-up dialog sessions, regular teachers from the summer session, co-teachers, curriculum directors, and the university professors engaged in lively discussions of the project's effects. They examined a variety of issues. The following discussions are representative:

- Unlike the middle and high school levels, science is not a "subject" that students take in the K-3 grades. Hence, what is done by these teachers to teach science must respect the K-3 domain. Also, this content and pedagogy must be arrived at on a building-by-building level through regular discussions and curriculum development.
- A substantial amount of dialog was devoted to exploring the strategies, obstacles, and ramifications for implementing the science kits in the different schools. These teachers and the professors said that a site-based model is the best way to proceed with science reform at the elementary level. They added that it is a step-by-step process and a long process. Nonetheless, someone needs to document the process through which the teachers developed their science curriculum as well as the results.
- Teachers occasionally engaged in discussions about situations in their different schools that could stand in the way of their implementing the changes. Teachers cited the following obstacles: a principal who does not offer adequate support, less than a critical mass of teacher colleagues in a given building, the politics of education that determines what science curriculum materials are bought for the entire district, and dictates of the Connecticut Mastery Test (CMT) that require all else be suspended for the 4th, 6th, and 8th grades until the tests are completed.
- It is essential that interaction be thorough and regular between leaders of a curriculum and professional development project, such as this one, and the school district's officials, especially with key individuals who have responsibility for the district's curriculum and professional development. If there is misunderstanding or, worse, the conviction that an outside agency is usurping the authority of the school district's officials, the project is doomed. Key participants in this project worked continuously on maintaining high quality relationships with the NHPS. Nonetheless, from time to time some misunderstanding occurred, which resulted in hurt feelings or somebody developing the impression, at least, that a territory was being threatened. When this occurred a stern notice would be sent to the proper authority. The principal investigator and other key players resolved all of these issues to the satisfaction of all concerned parties.

The emergence of delicate issues or controversies, such as negotiating authority, is to be expected in any undertaking of significance to a public school district. The central administration usually has one or more officials whose chief responsibility is to provide leadership in various areas of the instructional program. Thus, they would at least be curious, if not feel that their jobs were threatened by any concerted effort to improve or change the school's curriculum. NHPS district officials had high praise for this project's development, acknowledged its fit with the district's plans for improving the science curriculum, and pushed the project director to "think bigger," that is, involve more teachers and buildings and higher grade levels as soon as possible.

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SURVEYS

The surveys used for quantitative data collection were: a teacher questionnaire and a survey of teachers' skills and attitudes toward science. The purpose of the questionnaire was to assess the teachers' initial experience with and confidence in science and science teaching skills prior to beginning the program. The comprehensive teacher survey provided additional data on the teachers' perceptions before beginning the program but had its primary focus on the program's effect on teachers' skills and attitudes toward science. A secondary purpose was to find out how a teacher's participation in the program impacted on their students and on the science curriculum in their school and district. This data was useful for assessing the program's current success and making recommendations for maintaining and improving the program in the future.

QUANTITATIVE EVALUATION DESIGN

Dr. Charles Bruckerhoff of Curriculum Research and Evaluation developed the Survey of Teachers' Skills and Attitudes Toward Science Teaching and Learning. This survey consisted of three sections of closed items in which the teachers rated the impact of each item on professional development, curriculum development, or impact on classroom, building, and district. Open-ended items allowing teachers to describe and explain the impact of the program in general and in these three areas were also included on the survey. The teachers' questionnaire consisting of nine open-ended questions was developed by the teacher leaders in the program. The content of the items for both instruments was generated by the program objectives as defined in the proposal submitted to the Eisenhower Fund.

The teachers' questionnaire was administered under the direction of the project leaders to the participants at the beginning of the 1996-1997 course introducing the STC science kits. Copies of the completed forms were sent to Curriculum Research and Evaluation during the summer session. The comprehensive teacher survey was mailed and returned to CRE by the participating teachers.

SUMMARY OF FINDINGS

The following list presents the results of the teachers' questionnaires and surveys. Analysis of the data that generated each finding is described in more detail within the report.

Demographics of Teacher Respondents *(Pages 8-9):*

- 85% of the teacher respondents felt that their previous education programs had not adequately prepared them to effectively teach elementary school science.
- 100% of the teachers have supplemented their own science education by engaging in relevant professional development activities and independent study.

Attitude Toward Science Before the Course *(Page 9-10):*

- The responding teachers view science as a very important component of a child's education either as a subject area on its own or as it integrates and enhances other subject and skill areas.
- 54% of the teachers were uncomfortable with their abilities to effectively teach science due to inexperience, lack of a stated curriculum, or adequate classroom materials.
- 47% of the teachers were confident in their abilities to teach science because of the district's curriculum, the grade level taught, or their past experiences.

Science Instruction Prior to the Course (Pages 10):

- Science units taught most often by the participating teachers included the human body, plants and animals, weather, and simple machines.

- 47% of the teachers reported using hands-on inquiry-based learning in the instruction of science.
- 62% of the teachers agree that they would improve their classroom science lessons with increased access to and availability of quality science equipment and materials.
- The three areas listed most often as necessary for improving science education in the schools were more materials, more hands-on inservice for teachers, and a defined science curriculum for each grade level.

Value of the Summer Course *(Page 11-12):*

- 70% of the teachers enrolled in the course to get new methods, ideas, experiments, and materials to use in their classrooms.
- 39% of the teachers enrolled to expand their knowledge of science.
- Teachers reported that they were intellectually stimulated and engaged in active learning during the course.
- Teachers reported that participation had an above average to high impact on their knowledge of science and on their ability to effectively teach it to their students.
- Teachers found that the practical hands-on nature of the course in addition to the opportunity to work with other teachers as effective means of enhancing their understanding of science content and methods of instruction.

Follow-up Sessions *(Page 12):*

- 65% of the responding teachers indicated that the follow-up sessions had an above average to high impact on their further knowledge of the teaching and learning of science.

Impact of STC Kits (Pages 12-13):

- Most teachers reported that they were using lessons from a science kit in their classroom.
- Building use and administrative support of the kits varied with some providing no additional funds or support while others were interested in developing building and district science curriculums based on the kits.
- Most teachers reported that their students were more motivated to learn science since the variety of high quality materials and resources available in the kit had led to positive changes in the methods of classroom instruction.
- 33% of the responding teachers reported changes in building level science instruction and in students' achievement levels with the use of the kits.
- 66% of the teachers had not seen much evidence of district-wide systemic change in the science curriculum and instructional strategies since the kits were introduced in the district.

Impact of Science Collaborative Program (Pages 13-14):

- 100% of the respondents reported that they had gained a deeper appreciation of science and were more confident with the content.
- 67% of the teachers reported an above average to high impact of the program on their competence with direct hands-on, inquiry-based, and problem-solving methods of teaching science.
- 50% of the teachers reported an above average impact on their competence level with the scientific reasoning skills method of teaching science.
- 83% of the teachers' gained above average competency in the use of the science kits.
- 67% of the teachers gained above average competency developing classroom activities which meet the goals of the New Haven Public Schools "Kids First."
- 50% of the teachers gained above average competency in creating empowered learning communities which use developmentally appropriate curriculum planning especially planning which meets the goals of the *National Science Education Standards*.

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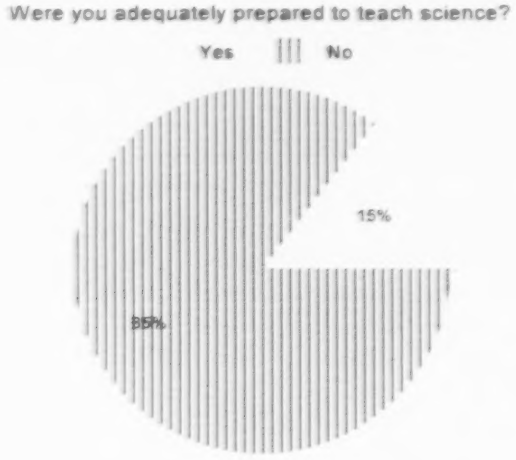
- 83% of the responding teachers described their building and district leadership concerning science curriculum as above average to high with 67% helping in the establishment of school-wide science curriculums based on the STC science kits.
- Lack of funds and schools' undefined science curricula are described as the most important barriers to substantial change in science education.

ANALYSIS OF SURVEY RESULTS

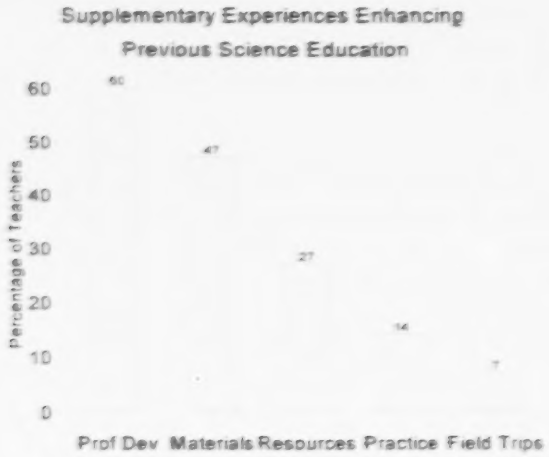
Demographics of Teacher Respondents. Participant data provided by the program directors shows that 15 teachers participated in the summer course and continuing program during the 1996-1997 school year. Of these teachers, 13 responded to the teachers' questionnaire generating data which represents 87% of the possible responses. Six of these teachers also responded to the teacher survey, providing data which represents 40% of the possible responses.



Science Courses Taken by Participating Teachers During their Teacher Preparation

astronomy	general science
basic science	genetics
biology	physical science
botany	physics
chemistry	physiology
earth science	

Although teachers had taken several different science focused courses in their teacher preparation program, 85% felt that they were not adequately prepared to teach science. Reasons for this included courses which had too many students, were too difficult and boring, and were not focused on the teaching of science.



Supplementary Experiences

Field Trips: pursuing different possibilities

Practice: writing units and conducting experiments

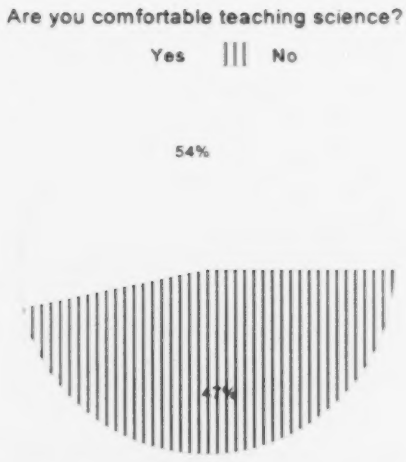
Resources: reading relevant materials, investigating library materials and studying the National Science Standards

Materials: buying unit material, purchasing through Science by Mail, and writing grants for new material

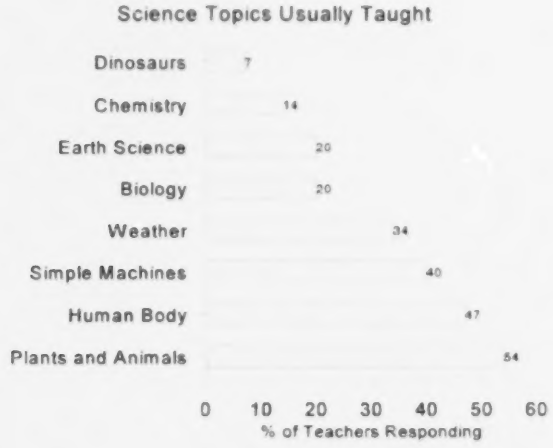
Professional Development: PIMMS, courses at Sacred Heart, AIMS, seminars and workshops, and attendance at the Yale New Haven Teacher Institute

Every teacher responding to the surveys indicated that they had supplemented their own science education over the years. The majority had engaged in professional development programs while some enriched their knowledge on their own through various resources.

Attitude Toward Science Before the Course. All of the teachers indicated that science education was very important. According to the responses, science education is vital to the overall education of children. It teaches children to explore, create, learn to be critical thinkers, and to understand their world. As a subject, science can be integrated into other disciplines and used to enhance basic skills. Responding teachers were almost evenly divided when asked to describe how comfortable they felt teaching science. The teachers who expressed concerns about their abilities to teach science cited lack of materials, experiences, and defined school science curriculums as the primary causes of this response. Some who were comfortable in this area qualified their responses by indicating that they were only responsible for a primary level of science knowledge or that they have access to well developed school science curriculums.



Science Instruction Prior to the Course. Teachers were asked to describe science lessons they usually teach in their classrooms. In addition to describing specific lessons, most respondents identified the science topics or areas they try to teach each year.



Teachers were also asked to describe the methods they use most often to teach science. The majority (47%) reported using hands-on inquiry-based learning methods. In addition most teachers used a variety of other methods including: discovery, cause and effect, prediction, integration, small group instruction, and experimentation. Teachers also used primary source books, activity guides, visual aids, science centers, and projects as means of science instruction.

According to the teachers, classroom science lessons would be improved if more assistance, materials, ideas, and organization were available in the school. In addition, some recognize their own need for more study. These same requirements are necessary for improving science education school wide as indicated by the responses.

Other: field trip opportunities, more involved staff, more visitors, and organized science fairs

Value of the Summer Course. The teachers were asked to explain what they hoped to gain from their participation in the program. Their answers were varied but focused most often on expanding their own knowledge of science or getting new ideas and materials to use in their classrooms.

The survey instrument asked teachers to assess the EDU 522 "Experimental Science I" class. On five items, teachers were to rate their responses to each item on a scale from 1 to 5 with 5 being

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the highest. The responses were analyzed to show the mean responses to each item. In addition, the ratings of 4 and 5 on each item were classified as above average to high impact and reported as a percentage. The majority of responses to each item were above average to high with a mean range of 4.17 to 4.83. The item rated as the highest by teachers was the amount of active learning engaged in by respondents during the course. The item with the lowest ranking was the course's focus on promoting a better understanding of the *National Science Education Standards*.

Assessment of "Experimental Science I" Course				
Items	Mean Ratings	Percentage of Responses		
		Above Av to High	Average	Below Av To Low
During the course you engaged in active learning	4.83	100%	0	0
Your knowledge and understanding of science was expanded	4.5	83%	17%	0
Your ability to effectively teach science improved	4.33	83%	17%	0
You gained a better understanding of the *National Science Education Standards*	4.17	67%	33%	0
The course was intellectually stimulating and educational for adults.	4.33	83%	17%	0

Follow-up Sessions. Two follow-up sessions were held during the fall semester following the course. More teachers attended the first session in September than the second in November. Some teachers attended both sessions. When asked to rate the impact of the sessions on the furthering of ones knowledge of teaching and learning of science on a scale from 1 to 5 with 5 being the highest, 67% percent of the teachers rated the impact of the sessions as above average to high. The remaining teachers rated the session as having a below average impact. The mean response given by the total set of responding teachers was 3.5 with teachers describing their impressions as favorable in that they felt confident in their abilities, were given a good overview of the kits, and were encouraged by the interest in science curriculum. One teacher did indicate that the sessions could have been more meaningful to the teachers but did not provide specific details.

Impact of STC Kits. Each participating school received a $500 grant to purchase one STC Science Kit. Most of the responding teachers purchased the "Technology for Children" Kit. In addition, some schools purchased additional kits with their own funds or with other grant money specifically for this purpose. In some schools only those who participated in the course are using the kits in their classrooms since other teachers are disinterested and administrative support for additional material is lacking. In other schools, the teachers in each grade level are piloting kits in their science classes. In one school, ten teachers have been trained and are using the kits with plans to increase the use to all twenty teachers next year. In many of these schools, principals are supportive of the program, helping to fund the purchase of additional kits, and promoting them as the science curriculum for the school.

The survey instrument asked teachers to assess the impact of the science kits on students, classroom instruction, and school wide curriculum development. On six items, teachers were to rate their responses on a scale from 1 to 5 with 5 being the highest. The responses were analyzed to show

the mean response to each item. In addition, the ratings of 4 and 5 on each item were classified as above average to high impact and reported as a percentage. The responses to each item were from average to high with a mean range of 3 to 4.5. The items rated as the highest were the impact the kits had on changing classroom instruction and encouraging student motivation to learn. The item with the lowest ranking was the impact of the kits to promote district-wide change in the science program.

Impact of the STC Science Kits				
Items	Mean Ratings	Percentage of Responses		
		Above Av. to High	Average	Below Av. To Low
Quality and variety of curriculum and resource material available in the classroom	4.25	75%	25%	0
Students' motivation to learn science	4.5	100%	0	0
Students' achievement in science	4	50%	50%	0
Changes in classroom instruction	4.5	100%	0	0
Changes in building level science curriculum	4	50%	50%	0
Evidence of district-wide systemic change in science education	3	33%	33%	33%

Impact of Science Collaborative Program. The survey instrument asked teachers to assess the impact of the science collaborative program on their professional development, their competence with methods of teaching science, and their work with curriculum development activities. On these items, teachers were to rate their responses on a scale from 1 to 5 with 5 being the highest. The responses were analyzed to show the mean responses to each item. In addition, the ratings of 4 and 5 on each item were classified as above average to high impact and reported as a percentage. The responses to the two professional development items were above average to high with means of 4.5 to 4.67. The teachers had become more confident and gained a better appreciation of science.

Teachers were also asked to rate the program's impact on four items focusing on the methods of teaching science. The responses were all average to high with a mean range of 3.83 to 4.17. Teachers felt the most confident in their abilities to use direct hands-on experience and problem-solving through investigation as methods of instructing science. Their abilities to use scientific reasoning skills as a method were less impacted. Responses to items focusing on curriculum development continued in the average to high level but had a mean range which indicated a lower rating than that given to the teachers' competence with teaching strategies. The mean range for these seven items ranged from 3.67 to 4.5. The greatest impact was on the teachers' record of curriculum leadership in their schools and districts while the least was on the teachers' perceived competence with developing curriculum which meets the *National Science Education Standards*.

Asked to describe their present involvement in curriculum development most of the teachers indicated that they had improved or redeveloped their classroom curriculums because of their experiences in the program. Many were also involved with school-wide initiatives to redevelop the school science curriculums by incorporating or focusing on the kits in each grade level. Asked to define the greatest barriers to achieving the educational changes promoted by this program, most

teachers cited lack of funds, administrative support, and defined science curriculums as the primary factors.

Impact of the Science Collaborative Program					
Items		Mean Ratings	Percentage of Responses		
			Above Av. to High	Average	Below Av. To Low
Professional Development	Has your confidence improved?	4.67	100%	0	0
	Have you gained a deeper appreciation of science?	4.5	100%	0	0
Competence with Methods of Teaching Science	Direct, hands-on experience	4.17	67%	33%	0
	Inquiry based learning	4	67%	33%	0
	Problem-solving through scientific investigation	4.17	67%	33%	0
	Scientific reasoning skills	3.83	50%	50%	0
Competence with Curriculum Development Activities	Effective use of science kits	4.33	83%	17%	0
	Development of classroom activities which meet the goals of "Kids First"	4	67%	37%	0
	Development of curriculum which meets the goals of the National Science Ed. Standards	3.67	50%	50%	0
	Developmentally appropriate curriculum planning	3.83	50%	50%	0
	Creation of an empowered learning community	4	60%	40%	0
	Present record of curriculum development in the classroom	4.4	80%	20%	0
	Present record of curriculum leadership in the school	4.5	83%	17%	0

CONCLUSIONS

From the data provided by the participating teachers on the questionnaire and survey instrument, the Science Collaborative Program is meeting its objectives for the teachers and is beginning to impact on the actual teaching and learning of science in the NHPS. Teachers have learned to effectively use the kits and recognize the benefits of the materials for supplementing and enhancing their science teaching plus the potential of the science kits to serve as a comprehensive science curriculum at the elementary level. Building administrators are becoming more supportive of the program and, along with the participating teachers, can probably encourage more classroom teachers within the buildings to invest in this concept for science teaching.

RECOMMENDATIONS

This section of the report includes a number of recommendations from teachers for improving the program. The majority of participants focused on these two areas: (1) encouraging more teachers to participate in the program and giving those who are involved the resources to train additional teachers and (2) to obtain further funding to maintain the program within their own school buildings. In addition, participants noted that the more invested were the teachers and principals, the greater was the likelihood that this program will succeed in effecting systemic change in science education in the New Haven Public Schools.

Specific recommendations for maintaining and improving the program were generated and summarized from responses provided by teachers on the questionnaire and survey.

- Build a critical mass of trained teachers within school buildings to promote use of these materials for developing or enhancing the school science curriculum.
- Encourage teachers who have shown a commitment to science education either in relevant teacher training programs or on their own to invest their time and efforts in this project.
- Encourage trained teachers to take leadership roles in their buildings in regard to the development of the science curriculum by helping to secure funding for additional kits, and serving as a teacher trainer and instructional model.
- Include a follow-up session which gives practicing teachers an opportunity to learn how to present workshops to their colleagues and gives them resources for securing grants and other funding for purchase of additional kits.
- Shorten the actual class time or plan for more activities and lessons.

APPENDIX

Letter to Connie Frazier

February 13, 1997

Ms. Connie Z. Fraser
Department of Higher Education
61 Woodland Street
Hartford, CT 06105-2391

Dear Ms. Frazier:

The purpose of this letter is to provide you with a brief report from the external evaluator on recent operations and developments that are associated with Dr. David Pettigrew's project, "Toward a K-16 Standards-Based Classroom: A Collaborative Model for Science Education," which is located at Southern Connecticut State University and for which he received an Eisenhower grant.

This past Saturday, February 8th, I visited an all day teachers' professional workshop which was held at Lincoln-Bassett Elementary School in New Haven. My objectives were: (1) to collect documentation on the impact of the "Collaborative Model" on the individual teachers who participated in the 1996 summer course, EDU 526 "Experiential Science Learning," that was co-taught by Ms. Margaret Andrews and Dr. James Dolan; (2) to observe the teacher trainers' impact on their peers; and (3) to assess the project's overall impact on and potential for success with the public schools of New Haven. I chose to visit Lincoln-Bassett because several teachers and the building principal at this school have actively participated in science education courses at SCSU which were supported by the 1996-97 Eisenhower grant.

Thus far, CRE has collected a substantial amount of documentation on this project, all of which indicates that the project is accomplishing its objectives in a timely and effective manner. This past Saturday, I was very favorably impressed by what I saw and heard at the workshop. Incidentally, this workshop is not a part of the grant *per se*, but rather is a spin-off of the grant that was sponsored by the New Haven Public School District, because its school administrators recognized how instrumental would be this next step beyond the Eisenhower grant. Thus, I thought that you would like to know what I found.

The educators who assembled at Lincoln-Bassett on this Saturday included Mr. David Howell, District Supervisor of Mathematics; Mr. Emanuel Stanfield, the building principal; Dr. David Pettigrew; Ms. Margaret Andrews, New Haven schoolteacher and workshop leader; Ms. Elizabeth Doherty, New Haven schoolteacher and workshop leader; and Ms. Donna Schlank, a schoolteacher at Lincoln-Bassett and the principal organizer of the event. Also, most of the teachers who work in

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Lincoln-Bassett school were present, several of whom had previously attended follow-up sessions for implementing the science teaching kits. Those follow-up sessions were sponsored by the Eisenhower grant. The current workshop was hosted Ms. Rita Schena, of Science and Technology For Children, and her assistants, who provided opening remarks and assisted with presenting workshops. The list of school district personnel who attended this workshop indicates how much they value this contribution to their professional development and to the future of science education for the elementary schools in New Haven.

The workshop began on time at 8:30 a.m. and proceeded through to the completion of its schedule at 2:30 p.m. in a highly professional manner. For instance, at the end of the registration period, I observed the teachers and their principal seated at several of tables in the library. They were all actively engaged in discussing this question: what is needed for an ideal elementary school science curriculum? Working in small groups and in a collaborative fashion, the teachers and their principal wrote their answers on several pages of chart paper and hung these up for a subsequent whole group discussion. Their answers represent some of the best current thinking on the this important and timely issue. Included among the items were: implementing standards-based curriculum, implementing a statewide curriculum framework for science, having statewide assessment that is tied to the curriculum frameworks and that includes authentic items, providing professional development of teachers, providing multiple high quality curriculum materials for classroom experiments, and helping teachers develop skill in the use of advanced technology for teaching and learning. These professional educators were highly committed to their work. There was no grousing and there was no off-task behavior at this workshop.

Next, the teachers assembled in small groups by grade level for workshops that were devoted to these topics: senses, weather, balancing and weighing, plants and growth development, electric circuits, and floating and sinking. I took the opportunity to visit Ms. Doherty's session on senses, which she delivered to Lincoln-Bassett's Kindergarten teachers. I also visited with Debbie Billington (of STC), who worked with the second grade teachers on balancing and weighing, and Ms. Andrews' session on plants and growth development for the third grade teachers.

In each instance, I observed a teacher trainer who is very well informed about her speciality, on the curriculum materials and instructional processes recommended for teaching the science content, and on the best practices to use when instructing peers. The participating teachers received a thorough introduction to the science content and the processes of instruction that are sure not only to attract and hold the students' attention—whatever their grade level—but also will lead to their learning these essential science skills and knowledge. The teacher trainers, in particular Ms. Andrews and Ms. Doherty, drew upon their prior professional experience when providing the other teachers with numerous, clear, and appropriate examples for how to teach the content. In this way the workshop sessions were believable to the teachers because real teachers—their own peers in New Haven—had tried this material and found it to be good for their teaching.

During the workshop sessions, there were frequent opportunities for the participating teachers to ask questions about the lessons and to engage in discussions with each other about the likely, practical results for the children they teach. Throughout the day the teacher trainers and their peers engaged in discussions about the implications of teaching this science content— in this manner and with these materials—to the urban children, especially the children who are from African American and Hispanic families. There was no doubt in anyone's mind that this was "just right" for their

elementary school children in New Haven. Now, these children will learn about science in a most exciting, challenging, and beneficial manner.

The workshop's afternoon schedule provided the teachers with opportunity to visit different sessions and engage in more broadly-based discussions with their colleagues about the implications of using these materials for teaching science at their school. Later, each small group of teachers gave a presentation to the whole group on their findings. This led to questions and discussions of their findings by the whole group. At the end of the day, the teachers took up the question of what to do about their school's goals for science education.

At one point, Mr. Howell mentioned to me that Lincoln-Bassett is being considered as a model school site for science education. He and Diane Garber, the Curriculum Director for the New Haven Public School District, came to this conclusion as a result of observations they made while attending the follow-up sessions at SCSU. In other words, due to the activities associated with the grant, the teachers' positive response, and the quality of the follow-up sessions, these district administrators would take steps to institutionalize these changes, starting with Lincoln-Bassett. On the basis of the observations that I made, this decision would be a wise move for the New Haven Public School District.

Nonetheless, the important point for this letter is to inform you that this whole development at Lincoln-Bassett is due in no small part to the support you provided in the form of the Eisenhower grant to SCSU and the New Haven Public Schools for the "Collaborative Model for Science Education." Ms. Andrews had served as co-teacher for the EDU 526 summer course with Dr. James Dolan. Ms. Doherty had enrolled in that course to fulfill her requirements for the Masters degree, and for some time now Ms. Schlank has been active in co-teaching science education courses with the SCSU university professors and has been instrumental in the professional development of her peers.

The school teachers, district administrators, and university professors have succeeded not only in fostering a climate for restructuring science education at Lincoln-Bassett Elementary School, but also they are succeeding handsomely with implementing a professional development program for elementary teachers that will lead to lasting, institutional change in this building and, quite likely, for the New Haven Public School District as a whole. The most important beneficiaries, of course, will be the children who live in this city and attend public schools like Lincoln-Bassett. It will be good for all if these teachers receive long-term, sustained support for this initiative.

In conclusion, I would like to mention what I believe are the underlying principles or themes which contribute to the success of this project—and many others like it. In doing so, I sincerely hope that this information will be of assistance to you in your ongoing efforts to help Connecticut's institutions of higher education improve the State's K-12 system of public school education. Incidentally, professors Pettigrew and Dolan at SCSU also deserve credit for their high quality contributions to the success of this project.

WHAT WORKS FOR TEACHERS' PROFESSIONAL DEVELOPMENT

- Focus on something the teachers need and want for their professional development.
- Workshop sessions and college courses or seminars should be available at the school as well as at appropriate off-site locations and should be taught by regular school teachers, who know their material and are recognized by their peers as effective leaders.
- Curriculum and professional development should be sustained over time, not only in the sense of time in one day (full or half day of work), but also in a given year and successive years in 3, 5, and 10 year planning cycles.
- Instruction must be given in a professional tone and style.
- Teachers should willingly collaborate with each other on building and district levels.
- Everyone should be held accountable for producing educational results or products that contribute positively to the improvement of the school's operations and educational climate *and* that contribute to the significant improvement of children's academic achievement.
- The principal and other district administrators should provide genuine assistance to the project in the form of financial, institutional, and moral support.
- There should be resources (e.g., libraries, technology and curriculum laboratories, courses, and seminars) provided by a nearby university that are conceptually and practically sound; and professors with specialities in relevant disciplines should be involved, who understand and support the efforts of school teachers and administrators to improve their professional development programs and curriculum and instruction.

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Thank you for the opportunity to evaluate this project. CRE looks forward to collecting more data and to writing the summative report at the conclusion of this important work.

All the best.

Charles Bruckerhoff, Ph.D.
External Evaluator

cc: Dr. David Pettigrew

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Survey Instruments

(Teacher-Developed Survey Instrument)

Name: Date:

Please answer each question completely.

1. Are you comfortable teaching science? Why or why not?
2. Do you feel your education program prepared you to teach science? What science courses did you take?
3. How have you supplemented your own science education?
4. How important do you consider science education?
5. What would help you improve your classroom science lessons?
6. What do you think would improve science education in your school?
7. What kinds of science lessons do you usually teach?
8. What teaching methods do you usually use when teaching science?
9. What would you like to get out of this class?
10. Comments.

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Charles Bruckerhoff is Principal Evaluator and Research Associate for Curriculum Research and Evaluation. He received his doctorate from the University of Wisconsin. He has taught English and reading at elementary and secondary schools. At the university, he taught graduate courses in curriculum and research methods. His research interests are educational reform and improvement, assessment, accountability, curriculum and instruction, and teacher education. He is the author of *Between Classes: Faculty Life at Truman High* and has written articles on curriculum development, qualitative research, urban collaboratives, and disadvantaged youth.

Theresa Bruckerhoff is Operations Manager and Research Associate for Curriculum Research and Evaluation. She has a Bachelors in Elementary Education and a Masters in Curriculum and Instruction. She has sixteen years of teaching experience ranging from preschool to the middle school levels. She taught in gifted programs, special education programs, and is an experienced classroom teacher. She has held executive board positions for child care centers and a nursery school. Currently, she studies state and national programs for teachers' professional development and school restructuring.

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